Clarification of pedagogical concepts

Here we firstly review the literature on what constitutes dialogic teaching. We then provide references to justify the relevance of this teaching approach; afterwards, we explain why this approach, despite the research supporting it, has not been more widely implemented. On the third part, we explain how technology might help in the implementation of dialogic teaching and then examine the ways in which dialogue systems specifically are being used in education.

What is dialogic teaching?

Dialogic teaching principles

As was briefly explained in the Definitions section (1.2), dialogic teaching is a pedagogic approach (i.e. not a method, but rather a philosophy that can be reflected in very differentpractices) where the focus is on talk. This is not to say that talk is not already present in most teaching practice, but dialogic teaching moves away from traditional monologic practices where teachers speak and the students' role is only to listen to answer the occasionalclosed question (Alexander, 2010); in dialogic teaching, students are active participants (ibid). The reasoning for this approach stems from Vygotsky and Bathkin's theories that language is our tool for knowledge construction both in our minds and through interactionwith others: truth is found via dialoguing with others, and to integrate that truth into our understanding of the world, we must put it into our words (i.e. our own voice) (Vygotsky, 1978, in Mercer, 2010). These philosophical theories are translated into the five principlesthat define dialogic teaching; talk, in order to be truly dialogic and conducive to learning, needs to be collective, reciprocal, supportive, cumulative and purposeful (Alexander, 2010).

Collectivity: this principle means that there is more than one participant: it is not a monologue where only one person speaks; instead, two or more people may intervene (ibid).

Reciprocity: this is very closely related to the first principle; it is not enough that more than one person participate, they also have to be active speakers, as well as active listeners (Skidmore, in Mercer et al., 2019).

Supportiveness: all participants feel that they are allowed to contribute, that they will be listened to, and that all participants will cooperate to understand each other (Alexander, 2010).

Cumulativeness: ideas have to be built upon; they need to be analyzed and evaluated, and questions need to lead to further questions for further knowledge construction (ibid).

Purposefulness: dialogue, to be pedagogical, needs to have a purpose. Though students' ideas may sometimes lead to topics outside the curriculum which are worth exploring, classroom activities need to be designed to reach a desired learning goal (ibid).

Scaffolding

It is important to bear in mind that dialogic teaching is a teaching approach; therefore, while the dialogic aspect warrants attention, the teaching aspect is also important. This implies that there not only needs to be dialogue in general, but also scaffolded dialogue (Alexander, 2010). Scaffolding is a type of guidance where supportive dialogue is used to lead the student through the steps of a problem and, as the student progresses, the support becomes less necessary and is gradually removed (Mitchell et al., 2013). As much of the basis of dialogic teaching, this idea stems from Vygotsky's theories, specifically that learning involves moving from "other-regulation" to "self-regulation" and from "inter-mental" activity to "intra-mental" activity: we build knowledge by interacting with others,until we assimilate it into our own voice and it becomes our knowledge (Vygotsky, 1975, in Mitchell et al., 2013).

Dialogic teaching indicators

Alexander's principles of dialogic teaching, though influential, are deeply rooted in theory, so they may not be useful for determining whether dialogic teaching is taking place in a class (Sedova, 2017). Principles have thus been linked to indicators that are easier toanalyze (ibid). Different authors have analyzed the implementation of dialogic teaching indifferent ways, sometimes focusing on the learning outcomes (Jay et al., 2017), assumingthat dialogic teaching is really taking place. Sedova (2017) proposes a set of five indicatorsthat were effectively used to assess the implementation of dialogic teaching in a longitudinalstudy, where the indicators could be used to analyze individual lessons and observe theprogression of the implementation process (i.e. seeing how dialogic each class was and howmore or less dialogic they became). The five indicators are: students reason their ideas,teachers ask open questions that require students to think, there is uptake (i.e. ideas arefollowed by new questions or contributions that expand upon that idea), and there is opendiscussion (i.e. there are several participants each talking for at least thirty seconds) (ibid).

Parallel to Alexander's principles and the ensuing indicators, Mercer et al. (2010b) also offer some signs of dialogic teaching taking place which are based on observations ofstudents participating in collaborative tasks (i.e. where a group of students work towards a shared goal). One first important conclusion that can be extracted from these observations(ibid) is that putting students in a group does not mean that there will be collaborative work - for there to be successful dialogue, some rules need to be set and enforced (Alexander,2010). This is linked to the main conclusion of the observations, where Mercer et al. (2010b) describe the three broad types of talk that the students engaged in and what talk type is conducive to learning (and should be fostered) and which one hinders learning (and should be discouraged). The three types of talk are: exploratory talk, cumulative talk (not to be confused with Alexander's principle), and disputational talk (ibid).

Exploratory talk is what was linked to dialogic teaching, as it involves students expressing ideas in a reasoned manner and building up on each other's views - all in line with Alexander's principles. Mercer et al. (2010b) also observed what they called cumulative talk, where students simply revisit what has been discussed so far, seeing which ideas leadto which other ideas and which ones were agreed upon. This in itself is not conducive to

learning, but it is a type of talk that Mercer et al. (2010b) observed frequently and considered positive, as it is linked to the important exploratory talk, and it is especially useful when students need to summarize their discussion to link their conclusions to the task goal. The remaining type of talk that Mercer et al. (2010b) observed is disputational talk, which is the type of talk that should be avoided (e.g. by enforcing rules that discourage it, such as "All ideas need to be reasoned"). In disputational talk, students are not respectful of each other's contributions (there is no supportiveness), they are monologic (they monopolize the task and/or not listen to other participants), and/or they do not reason their ideas (there is no cumulativeness, as conclusions do not stem from other ideas).

Importance of dialogic teaching

Dialogic teaching has been the subject of extensive research (Major et al., 2018), and efforts are being made to implement this teaching approach in schools (Sedova, 2017). This is due to two broad factors, further explained in the following subsections: firstly, learning to use dialogue, the basis of dialogic teaching, is an important life skill (Mercer et al., 2017); secondly, dialogue is a tool that can help learn other skills more effectively (Jay et al., 2017; Major et al., 2018).

Dialogue as an end

As was explained in the Definitions section (1.2), the skills that dialogic teaching employs and reinforces are called oracy skills (Mercer et al., 2017). In order to better understand why the acquisition of these skills is considered important, we need to first provide a more detailed definition of what these are. As we mentioned, oracy skills are communication skills understood as a large set of subskills, rather than simply speaking and listening (ibid). These subskills can be classified into four groups: physical skills, cognitive skills, linguistic skills, and social and emotional skills (ibid). Physical skills cover the use ofvoice and body language to communicate; cognitive skills cover the choice of content, clarifying and summarizing ideas, reasoning and analyzing views, managing time while we communicate, maintaining focus, and being aware of our interlocutors' understanding;linguistic skills cover the use of vocabulary, grammar, register, discourse structure and rhetorical techniques to communicate; social and emotional skills, finally, cover managinginteraction and turns, listening actively, and speaking confidently.

Possessing this wide range of skills has been linked to better employability and a highersocial status (ibid). Improving students' oracy skills also helps them participate more actively in class (ibid). For these reasons, it seems advisable to make improving students' oracy skills an important goal in their education. This is especially the case for cultures that have traditionally given less importance to these skills, as neglecting students' oracy skills development puts them at a disadvantage in a global society (Okada et al., 2018).

Dialogue as means

The development of oracy skills is not the only goal of dialogic teaching; this approach canbe used to teach different skills and curriculum topics (Jay et al., 2017; Major et al., 2018). Aside from helping achieve the specific goals of a course or lesson, dialogic teaching also has

broader cognitive benefits (Major et al., 2018). For example, higher oracy skills have been linked to higher problem-solving skills (Azmitia & Montgomery, 1993, in Mercer & Howe, 2012; Underwood & Underwood, 1999, in Mercer & Howe, 2012). Dialogic teaching has also been linked to improved reading skills: in interventions aimed at improving literacy, the best outcomes were achieved when students were encouraged to express ideas in their own words, instead of completing prompts or answering yes/no questions (Wolf et al., 2006, in Mercer & Howe, 2012).

Challenges for implementation

Research mentioned in the previous sections strongly suggests that dialogic teaching is a beneficial approach (Jay et al., 2017). However, its implementation is not easy (Sedova, 2017). One of the challenges is simply a lack of time, as packed curricula may leave little orno time for student participation (Mercer et al., 2010a). Another difficulty is that students' oracy skills may be very heterogeneous, making it difficult for all of them to participate in dialogic activities in class (Mercer et al., 2017). Students may be exposed to the same content at school, but outside the classroom their environments may be very different, and some may have no model of dialogue to imitate in their daily life (Mercer et al., 2017).

As significant as these obstacles are, one more challenging factor seems to be tradition and attitude (Mercer et al., 2010a; Sedova, 2017). Implementing a dialogic approach requires teachers (as well as students and administrators) reshaping their views and practices to understand the benefits of this approach and how it is to be applied (Merceret al., 2010a). Making classes more dialogic may involve significant changes for teachers used to different approaches; if teachers lack guidance to adapt their methodology to thisapproach, they may sometimes resort to old methods that are not in line with dialogic principles (Sedova, 2017). Even when teachers are offered formative programs to under- stand the principles of dialogic teaching, this is not enough if the programs do not includeadequate feedback that allows teachers to reflect on their practice (Sedova, 2017). This necessary training for teachers, as well as additional planning and reviewing, implies an investment of time and money (Jay et al., 2017).

Technology for dialogic teaching

Technology can help teachers and students overcome some challenges to the implementationof dialogic teaching, as demonstrated most significantly by the exhaustive literature review carried out by Major et al. (2018), which covers 71 studies on this topic. The first benefitof technology for dialogic teaching that is observed in this review is that technology helps students access each other's ideas and build cumulative knowledge (e.g. an internet forum can store contributions from a large number of students, exposing them to a wider varietyof views than could be covered in a traditional in-class discussion). The traceability of ideas also improves continuity across lessons (e.g. a computer can give access to documents from previous lessons and show who contributed what and when) (ibid). At the same time that previous ideas are visible, students can change and expand them: for example, while, for traceability, users may access the log of changes made to a document, they are also ableto easily edit digital content. This gives students flexibility and freedom and allows themto test ideas without fear of not having the correct answer (Mercer et

al., 2010b; Majoret al., 2018).

Technological tools also allow learning to occur outside the classroom, which is especially useful for students lagging behind or in situations where in-person learning is not possible (Major et al., 2018). Students in distance education report feeling isolated; also students in flipped classrooms, where only part of the work is done alone at home, miss having feedback during their autonomous work (Huang et al., 2019). Technology can tacklethese issues by providing students with instant feedback (e.g. quizzes that are automatically corrected), or adding new and sometimes more welcoming channels of communication with peers and teachers (e.g. a forum where questions can be asked anonymously or a chatwhere students can help each other). Additionally, technology can help teachers monitor students' work more closely, even in distance education (e.g. a log of students' work can be available to teachers, showing them where students had to try more times to get the right answer on a quiz, or which tasks took longer to complete); in class, this information about students' progress can also be made accessible to teachers, enabling them to provide better formative feedback without having to loom over the students, which might hinder their work or, in large classrooms, leave some students unattended (Mercer et al., 2010b;Major et al., 2018).

Whether in a classroom or in distance learning, technology that facilitates dialogic teaching can also improve the relationship between teacher and students and among students (Major et al., 2018). One specific way in which this can happen is that participationmay increase, possibly as a result of the motivating effect of interesting technology, dueto the supportive environment created by technology, or by the ability of technology to simulate discussions to prime students for that type of task (Goda et al., 2014; Major et al., 2018). Goda et al. (2014) observed this specifically with chatbots: students who used a chatbot for practice before a discussion participated more actively in it.

Another way that technology aids learning, as observed by Major et al. (2018) is its potential multimodality , which allows teachers to design lessons that appeal to different learning styles, as well as improve accessibility. Multimodality can mean simply combiningwritten and spoken communication, but also gestural communication in the case of systems with an avatar or robots (Heller, 2016; Thies et al., 2017; Marge et al., 2020). Multimodalityis specifically recommended for dialogue systems, as it makes communication more natural and increases the user's freedom (Jokinen, 2009). Jokinen (2009) also advocates for chatbot design that has accessibility in mind, as this then proves to benefit not only users with special needs.

Lastly, it is important to emphasize that any technology that is to assist in the implementation of dialogic teaching needs to be specifically designed with this approach in mind (Mercer et al., 2010b; Major et al., 2018). Many technological tools used in education are designed and implemented without a clear pedagogical purpose in mind, which leads totheir potential being unfulfilled or students' and teacher's needs not being met by the new tools (ibid).

Dialogue systems used in education

Some tools that were not specifically designed for dialogic teaching or for any kind of teaching approach, such as the interactive whiteboard, are being used successfully for the dialogic approach (Mercer et al., 2010b; Major et al., 2018). Dialogue systems might seem more ideally suited for this approach, as they are based on dialogue, which is the core of dialogic teaching. There is in fact widespread interest in the use of dialogue systems

in education, as exemplified by the EU-wide edubots project. Dialogue systems can be designed specifically for pedagogical purposes, even for concrete courses (Sahil et al., 2016; Huang et al., 2019).

Dialogue systems are being used for students at different levels, from small children (Ruan et al., 2019) to graduate students (Huang et al., 2019); however, this technology seems to be used mostly for higher education (Kuyven et al., 2018). There is also a wide variety of subjects and skills that these tools are being employed for, but the main focus seems to be on STEM, with many systems also being used for linguistic skills development (ibid). Additionally, a common use of dialogue systems in educational contexts is not directly related to education: many systems are designed for tasks such as informing students about enrolment or exam dates (Sahil et al., 2016).

As we have mentioned, some attempts have been made to use dialogue systems to develop linguistic skills - the focus is primarily on linguistic skills in a foreign language (Goda et al., 2014; Ruan et al., 2019). It can thus be said that systems exist which canhelp students reinforce at least some oracy subskills. One notable example is the work done by Catania et al. (2020). They provide a framework, tested through a Wizard-of-Oz study,for oracy skills development in children's native Italian language. The task to be completed through their system consists on describing their physical appearance to create an avatar;the focus is thus on linguistic subskills, though other subskills may also be practiced to some extent (e.g. the social subskill of responding appropriately or the physical subskill ofspeaking in a clear voice) (Mercer et al., 2017). Perhaps part of the potential shown by thissystem stems from the fact that it was a task-oriented system, which makes the interactioneasier to control (though the Wizard-of-Oz study makes it impossible to confirm whether this controlled setting would result in robust natural language understanding). Given the simplicity of the task, it cannot be said to meet all the principles of dialogic teaching (Alexander, 2010), but it is certainly purposeful and supportive. Many dialogue systems used in education are designed as chatbots (not geared towards completion of a task) using AIML[1] (Kuyven et al., 2018). This language makes it relatively easy to design a dialogue system (Heller, 2016; Kuyven et al., 2018). The resulting chatbot, however, may not converse with enough coherence for oracy skills development (Goda et al., 2014).

[1] Artificial Intelligence Markup Language. This markup language uses pattern matching to link userinput to suitable prewritten response templates. Templates can also include patterns to adapt to the context of the conversation.